

## CLAIMS

What is claimed is:

1. A process for forming a nanosize ceramic powder comprising:  
forming a precursor ceramic material comprising a fugitive constituent and a non-soluble constituent in a single phase;  
contacting the precursor material a selective solvent to form a solution of the fugitive constituent and a residue of the non-soluble constituent,  
the precursor sufficiently reactive with the solvent to form the solution of the fugitive constituent in the solvent and form the nondissolved residue of the non-soluble constituent  
the precursor material and the non-soluble residue sufficiently insoluble in the solvent such that there is insufficient precursor material and non-soluble residue in solution to deposit and precipitate upon the residue of the non-soluble-constituent,  
the fugitive constituent being sufficiently soluble in the solvent such that the precursor reacts with the solvent to form a solution of the fugitive constituent without precipitation and deposition of fugitive constituent upon the residue of the non-soluble constituent in the form of nanosize particles;  
removing the selective solvent solution from the residue to form a nanosize powder of the non-soluble constituent.
2. The process as in Claim 1 wherein the precursor is  $\text{BaCe}_{(1-x)}\text{RE}_x\text{O}_{3-\delta}$  or  $\text{SrCe}_{1-x}\text{RE}_x\text{O}_{3-\delta}$  and the composition of the nanosize powder is  $\text{Ce}_{1-x}\text{RE}_x\text{O}_{2-\delta}$  where RE is a rare earth metal or Y, x is between 0 and about 0.25, and  $\delta$  is between 0 and about 0.13.
3. The process as in Claim 1 wherein the precursor is  $\text{BaZr}_{1-x}\text{RE}_x\text{O}_{3-\delta}$  or  $\text{BaZr}_{1-x}\text{RE}_x\text{O}_{3-\delta}$  and the composition of the nanosize powder is  $\text{Zr}_{1-x}\text{RE}_x\text{O}_{2-\delta}$  where RE is a rare earth metal or Y, x is between 0 and about 0.25, and  $\delta$  is between 0 and about 0.13.

4. The process as in Claim 1 wherein the composition of the resultant nanosize powder is  $\text{Al}_2\text{O}_3$ .
5. The process as in Claim 3 wherein the precursor is selected from the group consisting of  $\text{BaAl}_2\text{O}_4$ ,  $\text{Ba}_3\text{Al}_2\text{O}_6$ , and  $\text{NaAlO}_2$ .
6. The process as in Claim 1 wherein the composition of the resultant nanosize powder is  $\text{Cr}_2\text{O}_3$ .
7. The process as in Claim 6 wherein the precursor is  $\text{MgCr}_2\text{O}_4$ .
8. The process as in Claim 1 wherein the composition of the resultant nanosize powder is  $\text{ZrO}_2$ .
9. The process as in Claim 8 wherein the precursor is  $\text{BaZrO}_3$ .
10. The process as in Claim 1 wherein the composition of the resultant nanosize powder is  $\text{TiO}_2$ .
11. The process as in Claim 10 wherein the precursor is  $\text{MgTiO}_3$ , or  $\text{Mg}_2\text{TiO}_4$ .
12. The process as in Claim 1 wherein the composition of the non-soluble constituent and the nanosize powder is  $\text{V}_2\text{O}_5$ .
13. The process as in Claim 12 wherein the precursor is  $\text{Na}_4\text{V}_2\text{O}_7$ .
14. The process as in Claim 1 wherein the selective solvent is water.
15. The process as in Claim 1 wherein the selective solvent is an acid.
16. The process as in Claim 15 wherein the acid is selected from the group consisting of  $\text{HNO}_3$ ,  $\text{HCl}$ ,  $\text{H}_2\text{CO}_3$ , and  $\text{H}_2\text{SO}_4$ .
17. The process as in Claim 15 wherein the acid is contacted with the precursor with an acid gas.

18. The process as in Claim 17 wherein the acid gas is  $\text{SO}_3$ ,  $\text{N}_2\text{O}_5$ ,  $\text{CO}_2$  or  $\text{HCl}$ .

19. The process as in Claim 1 wherein the selective solvent is a reacting gas dissolved in a non-aqueous polar solvent.

20. The process as in Claim 19 wherein the polar solvent is selected from the group consisting of formamide, N-Methyl-acetamide, N-Methyl-formamide, N-Methyl-propionamide, propylene carbonate, and ethylene carbonate, and the reacting gas is selected from the group consisting of  $\text{CO}_2$ ,  $\text{SO}_3$ ,  $\text{SO}_2$ , and  $\text{N}_2\text{O}_5$ .

*Sub P2* 21. A process for forming a nanosize metallic powder comprising:  
forming a precursor metallic material comprising a fugitive metal constituent and a non-soluble metal constituent in a single phase;  
contacting the precursor material a selective solvent to form a solution of the fugitive constituent and a non-dissolved residue of the non-soluble constituent, the precursor sufficiently reactive with the solvent to form the solution of the fugitive constituent in the solvent and form the non-dissolved residue of the non-soluble constituent  
the precursor material and the non-soluble residue sufficiently insoluble in the solvent such that there is insufficient precursor material and non-soluble residue in solution to deposit and precipitate upon the residue of the non-soluble-constituent, the fugitive constituent being sufficiently soluble in the solvent such that the precursor reacts with the solvent to form a solution of the fugitive constituent without precipitation and deposition of fugitive constituent upon the residue of the non-soluble constituent in the form of nanosize particles;  
removing the selective solvent solution from the residue to form a nanosize powder of the non-soluble constituent.

22. The process as in Claim 21 wherein the precursor is an alloy or an intermetallic compound.

23. The process as in Claim 21 wherein the precursor is  $\text{PaPd}$ .

- [illegible]